Science and Technology Research Partnership
for Sustainable Development : **SATREPS**

International Symposium on Earthquake & Tsunami Disaster Reduction
-Learning from the Great East Japan Earthquake–

Earthquake Engineering Research in Peru and SATREPS Project

March 15, 2012

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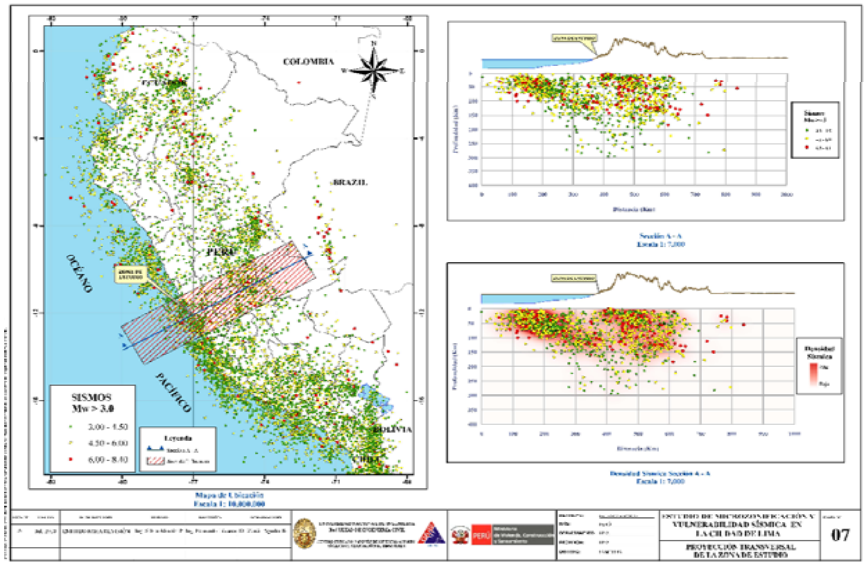
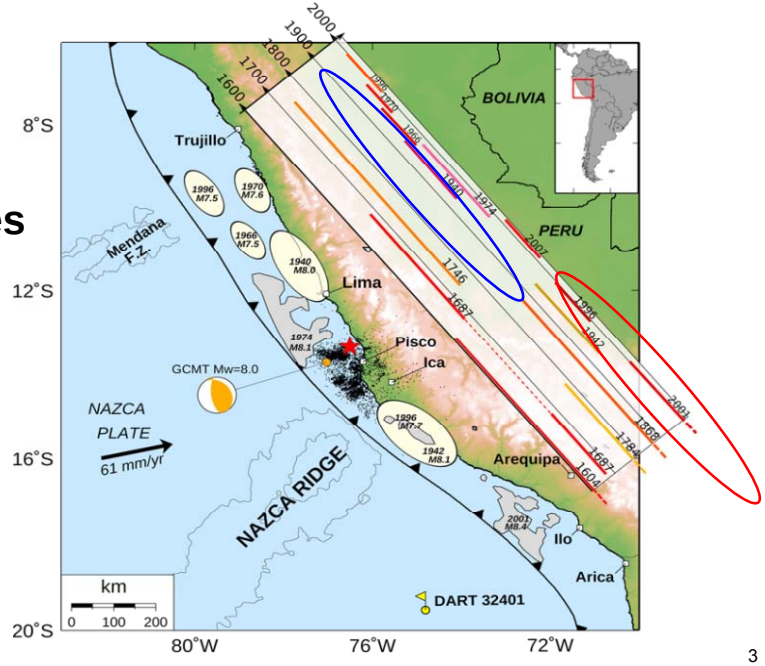
Subduction Zone and Earthquake Sources in Peru

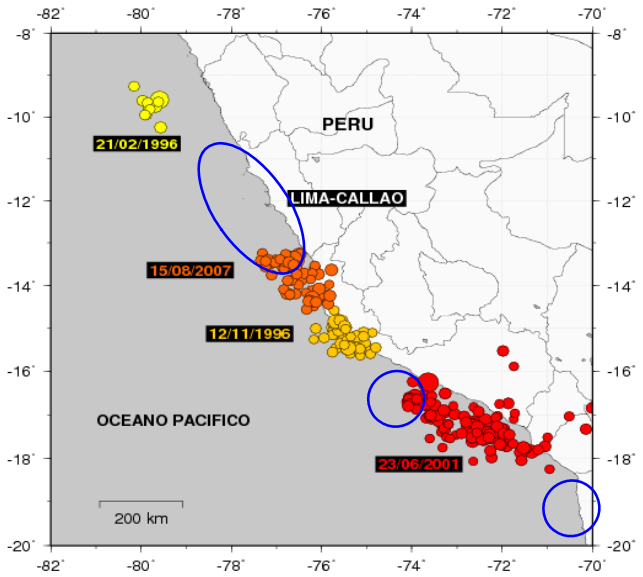


Scenario Earthquakes

1746 (Mw=8.6)
and
1868 (Mw=8.8)



Location of Earthquake hepicenters that produce tsunami in Perú



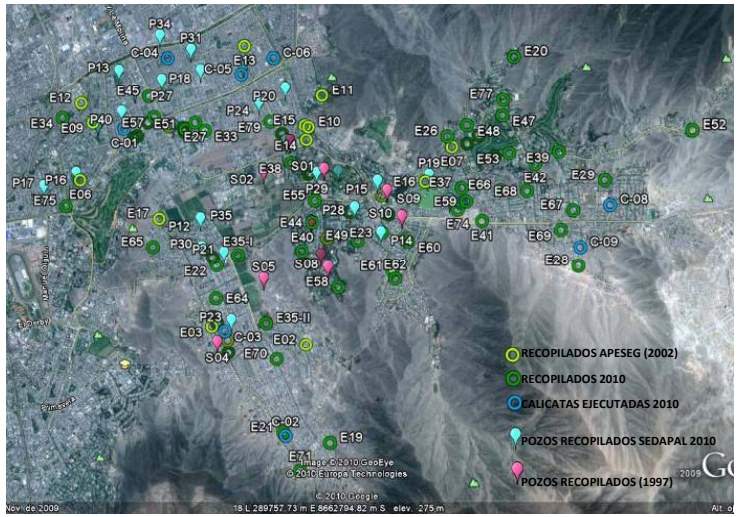
STUDY CASE

LA MOLINA DISTRICT

SAN JUAN DE LURIGANCHO DISTRICT

SOIL EXPLORATION

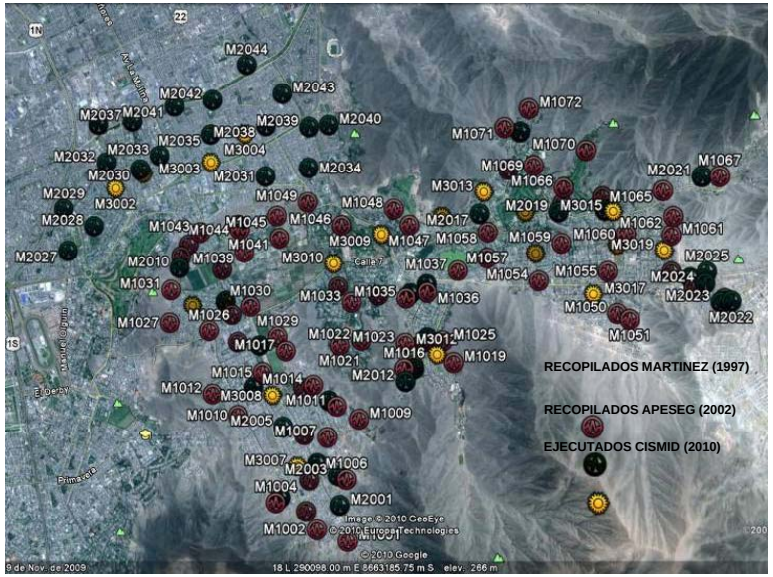
SOIL EXPLORATION AND PREVIOUS INFORMATION



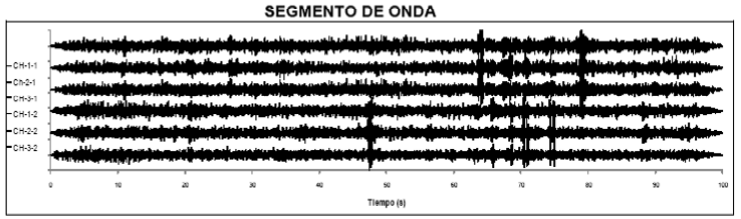
MICROTREMOR MEASUREMENT

GEODAS-10 Microtremor
SATREPS project

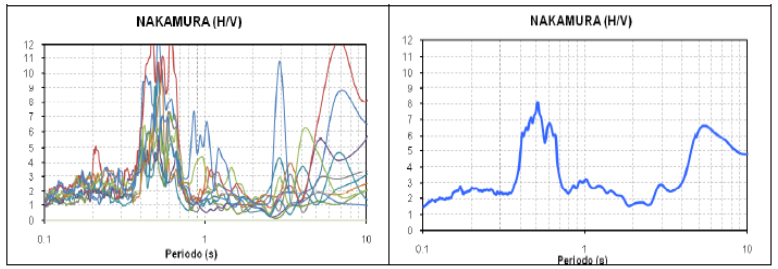
MICROTREMOR MEASURE POINTS AND PREVIOUS INFORMATION



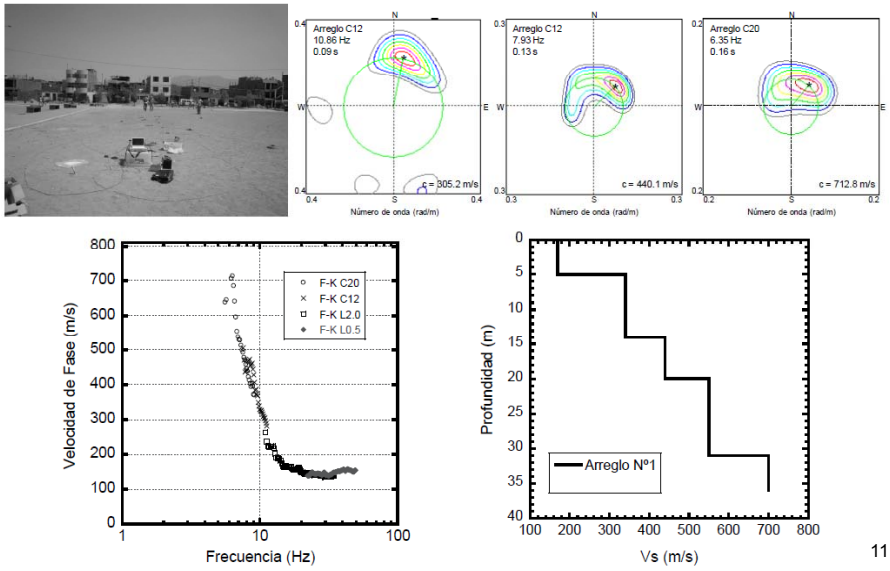
MICROTREMOR RECORDS

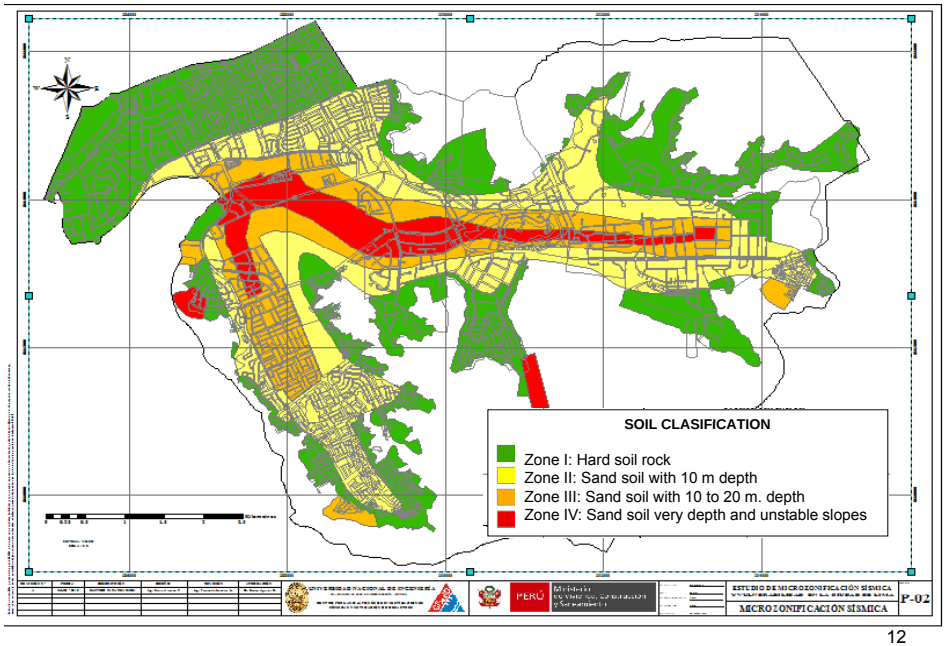


Espectral Ratios using Nakamura´s Method

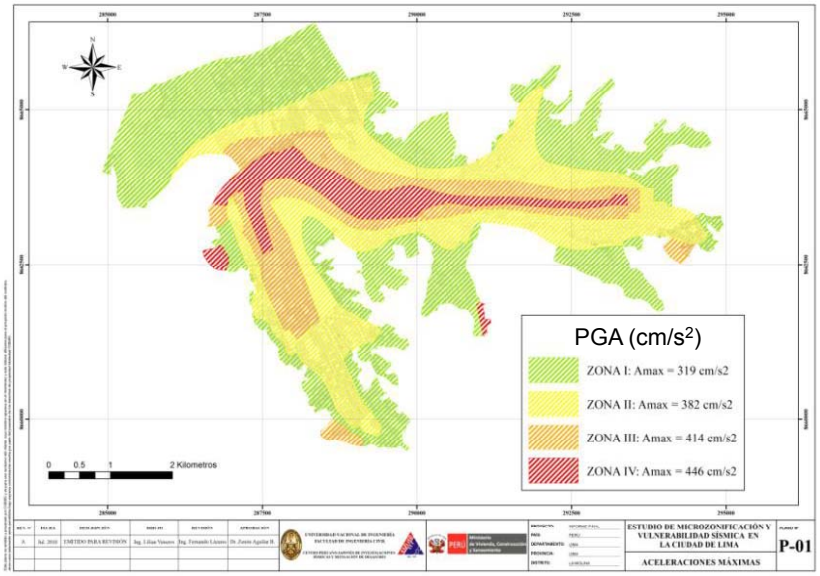


Use of Microtremor Array Measurement for Estimating Shear Wave Profile (Quispe et al, 2011)

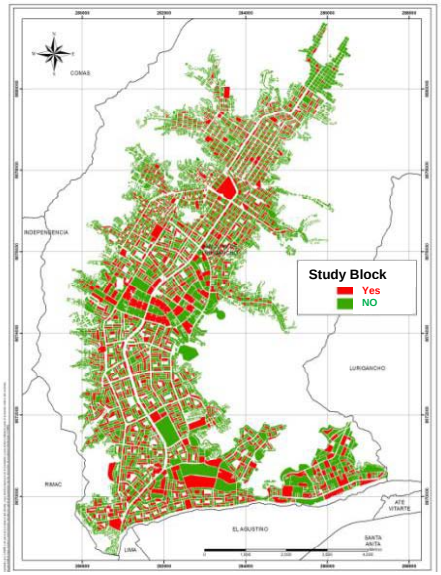


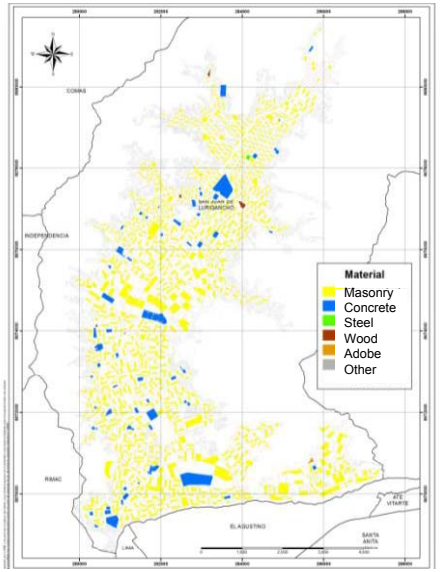


Maximum Accelerations in La Molina (PGA)

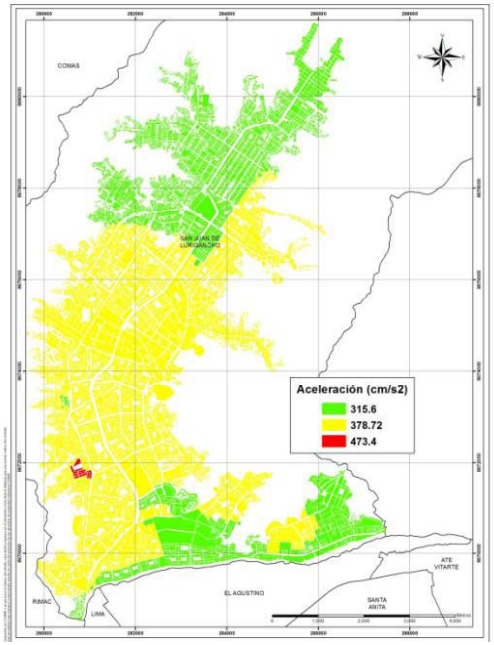


SAN JUAN DE LURIGANCHO DISTRICT STUDY BLOCKS AND MATERIALS





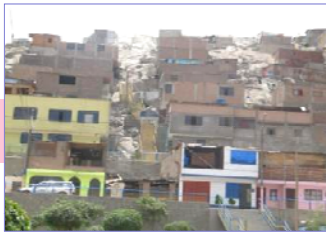
Maximum Accelerations in San Juan de Lurigancho (PGA)



The Truth of the Buildings in Peru

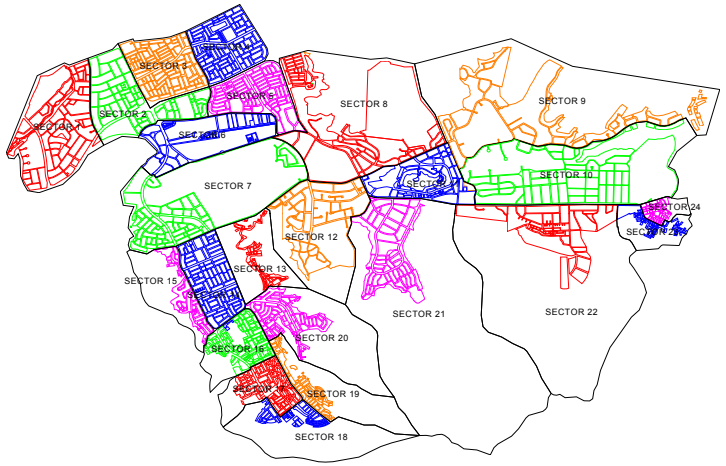
30% Engineering constructions

70% Non Engineering constructions



Urban Inventory

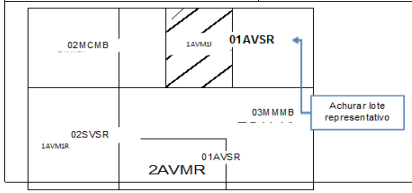
District Sector



DATA base generation & Field Survey

CONVENIO CISMID/FIC/UNI - MINISTERIO DE VIVIENDA CONSTRUCCIÓN Y SANEAMIENTO
ESTUDIO DE RIESGO SÍSMICO DEL DISTRITO DE LA MOLINA

CÓDIGO DE LA MANZANA:		CÓDIGO INTERNO:		
ESTRUCTURACIÓN				
Material	Adobe	Mamposteria	Concreto	**Observaciones**
Estado de Conservación	Bueno	Regular	Malo	
Cimentación	Asentamiento	Sí	No	
	Humedad en la Base	Sí	No	
Techo				
Adobe	**Mamposteria**	**Concreto**	**Otros**	
Madera	Losa de CA	Losa de CA		
Caña	Aligerado	Aligerado		
Torta Barro	Calamina	Placa Colaborante		
Otro	Otro	Otro		
Elementos Estructurales				
Fisuración				
Columnas	Fisuras	**NOTA**	Fisura Vertival (V)	
Vigas	Fisuras	Sin Fisuras (X)	Fisura Diagonal (D)	
Muros	Fisuras		Fisura Horizontal (H)	
Estado de Muros				
Unidad	Artesanal	Industrial	Sólido	Tubular/Hueco
Confinamiento	Si	No		
Fisuras	Si	No		
Tarrajeo	Si	No		
Estado de conservacion	Bueno	Regular	Malo	



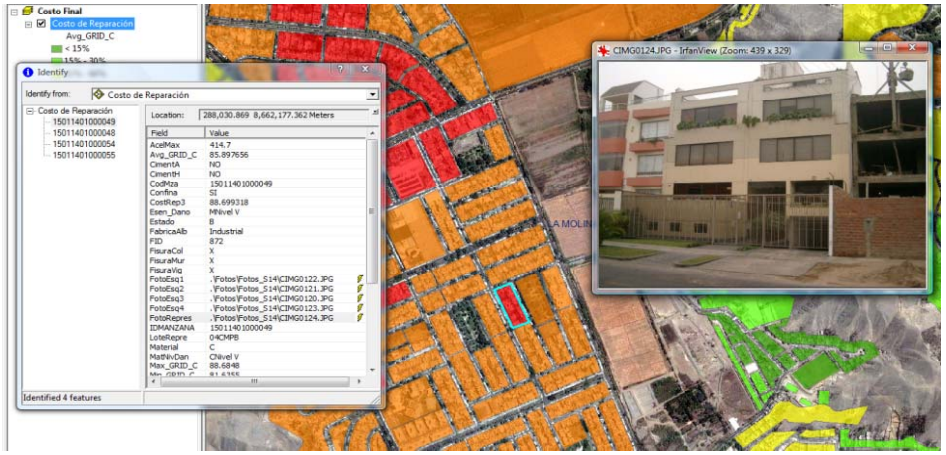
Nota 1: La información de la manzana debe estar en plano lotizado adjunto, similar al ejemplo de llenado que se muestra.

LEYENDA PARA LA CODIFICACIÓN DEL LOTE

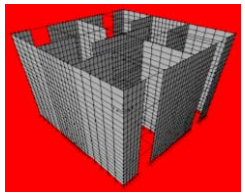
(1)	1	01	
(2)	Adobe	A	
(3)	Vivienda	V	**01AVSR**
(4)	Mamposteria de Arcilla Sin Refuerzo	S	
(5)	Regular	R	

Nota 2: No Evaluado Use (X)

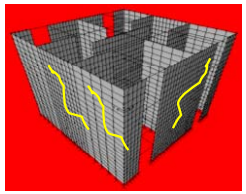
Geospatial DATABASE



Seismic Risk Evaluation



Building



Earthquake damage

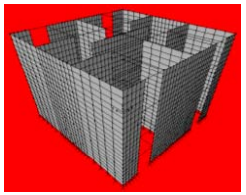
- Take plaster of walls S/.
- Put wire mesh S/.
- Put new plasterS/.
- Paint S/.

Retrofitting Cost

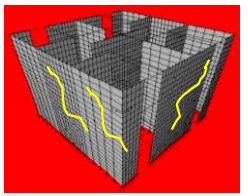
Retroffiting Cost = Function (Structure Type, PGA, Damage level)

- Urban Inventory
- Seismic Microzoning
- Vulnerability Laboratoty Test

Seismic Risk Evaluation



Building



Damage Level

Fundamental Period
T= 0.07 Np (1+ 0.75. Z. g/981)

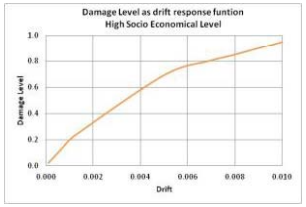
Sa = Aceleración on Microzone

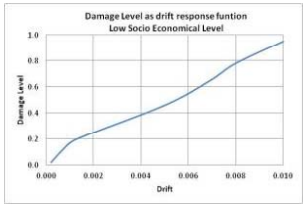
w= 2π/T
Sd= Sa /w^2

γe= Sd H =drift

γi=γe x (0.75 R)

γ= FR* γi

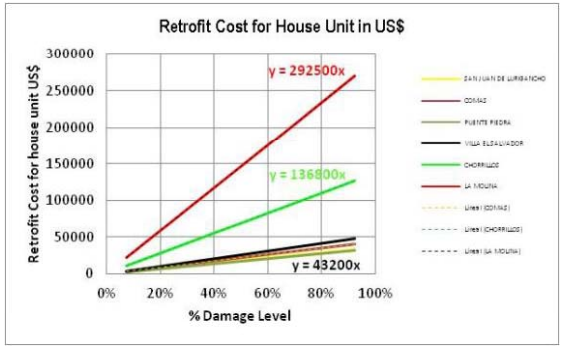




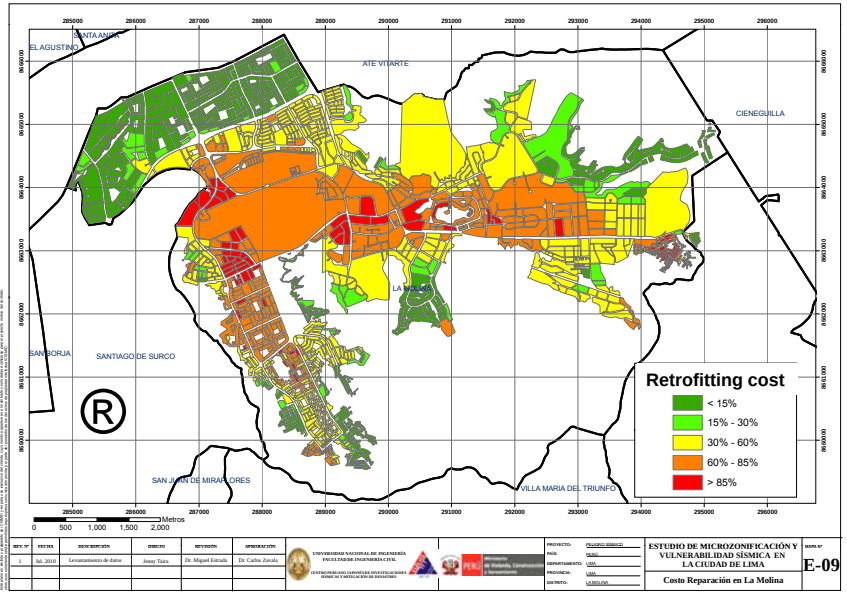
USING DAMAGE MATRIX AND PARAMETERS FROM 6 DISTRICT STUDY
A RATRIO DAMAGE LEVEL AND RETRIFFTING COST WAS DEVELOPED

Proyecto CISMID-PGT-BID

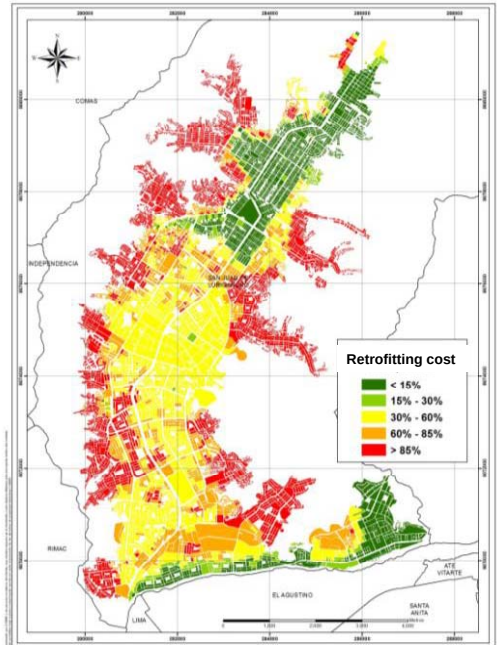
Distrito	Lotes/Mza	Area Lote Prom(m2)	Reposición (US$/m2)
SAN JUAN DE LURIGANCHO	20	130	275
COMAS	18	160	300
PUENTE PIEDRA	18	160	235
VILLA EL SALVADOR	20	130	400
CHORRILLOS	18	160	950
LA MOLINA	18	250	1300



Seismic Risk scenario on La Molina

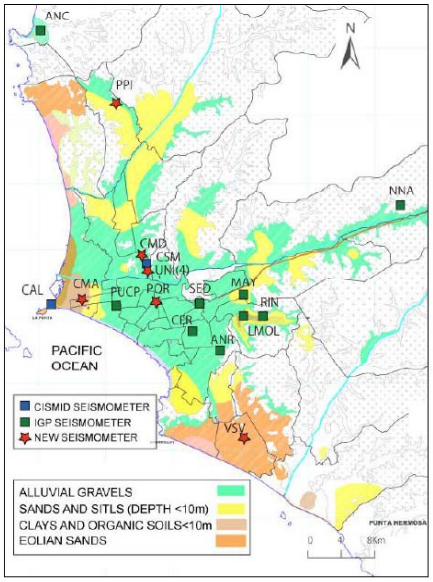


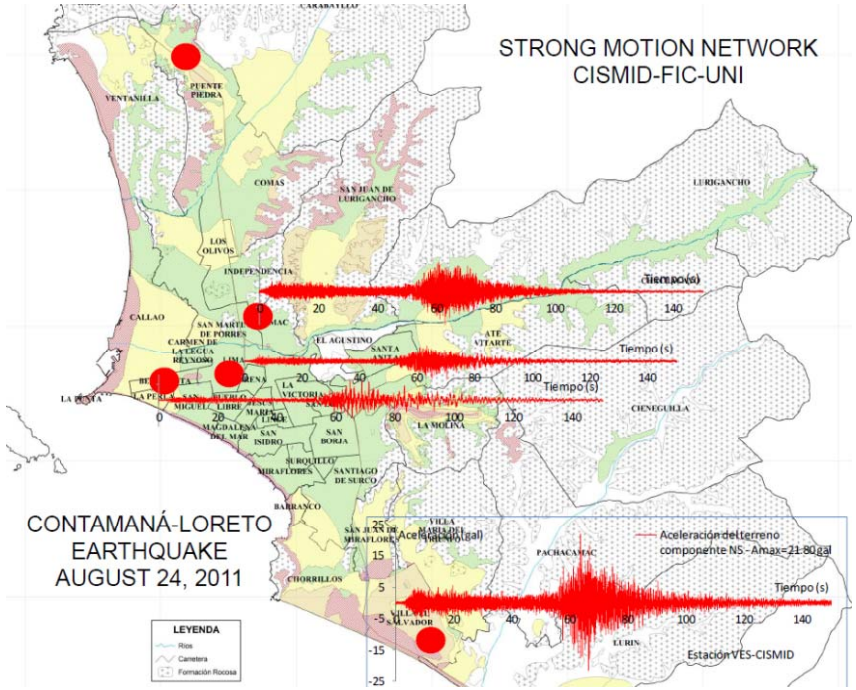
Seismic Risk scenario on San Juan de Lurigancho



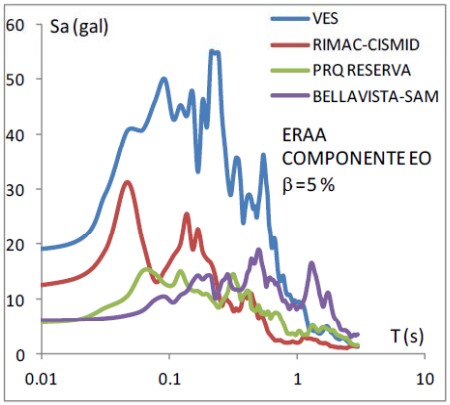
SATREPS OUTPUTS RELATED WITH APPLICATION OF NEW EQUIPMENT

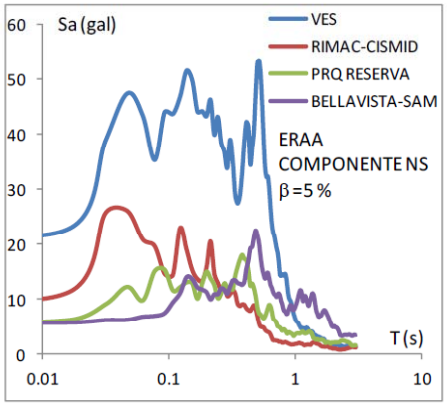
Seismometer implemetation on SATREPS Project

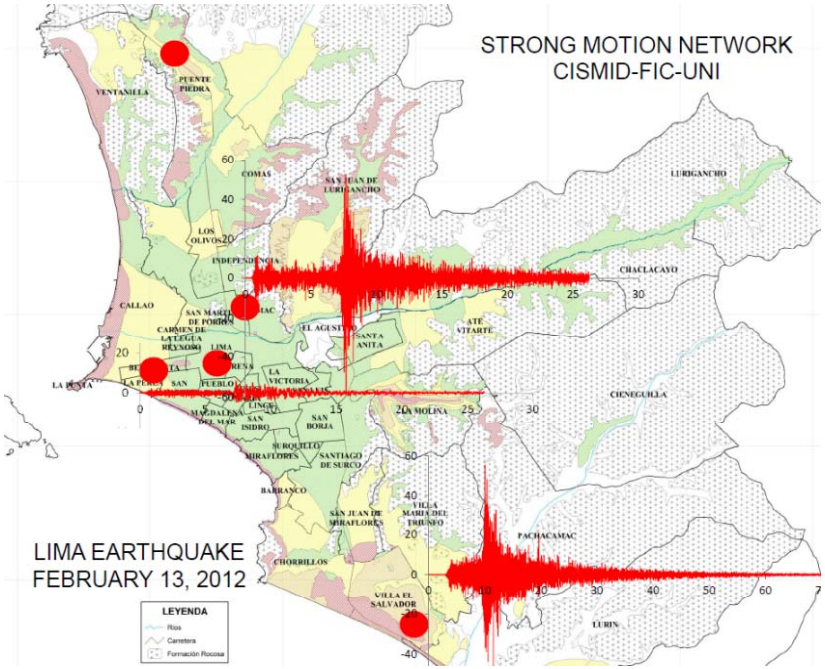




SISMO DE CONTAMANÀ-24/08/2011
SUPERPOSICIÓN DE ESPECTROS DE RESPUESTA







NATIONAL UNIVERSITY OF ENGINEERING
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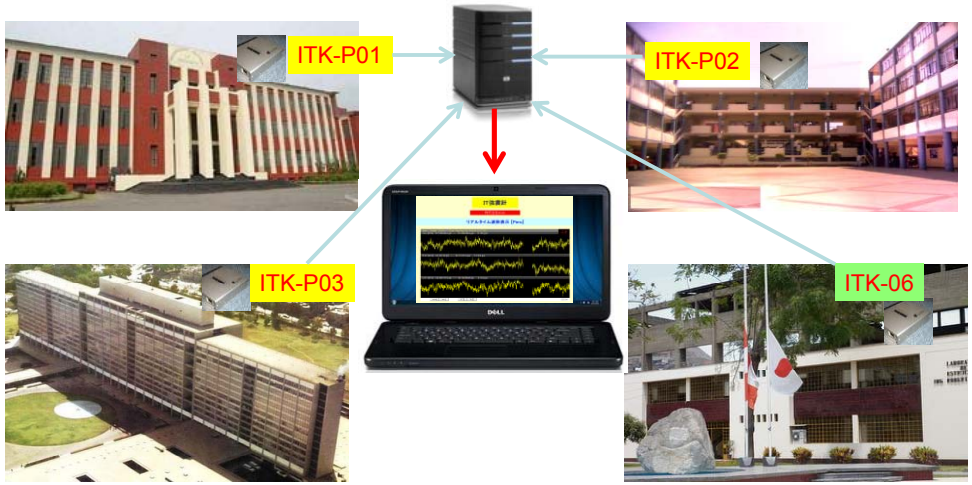
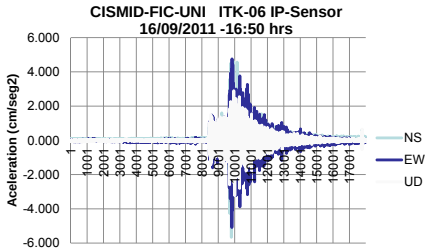
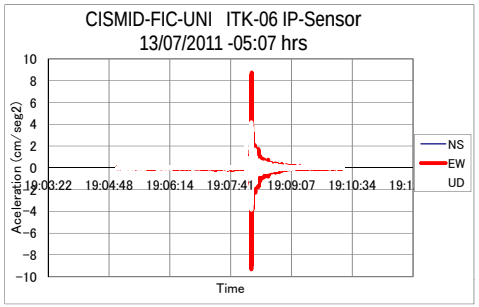
JAPAN-PERU CENTER FOR EARTHQUAKE ENGINEERING RESEARCH AND DISASTER MITIGATION - CISMID

ITK Sensor Monitoring Network

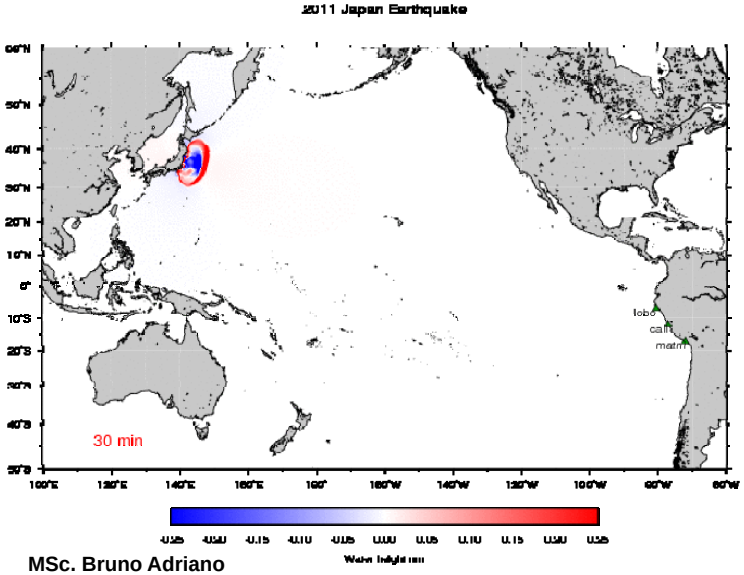


Capture Signal at Structural Lab CISMID-FIC-UNI





Wave Propagation arrival simulation to Peruvian Costal areas on 11/3/2011 Tohoku Tsunami



MSc. Bruno Adriano

LOW DUCTILITY WALL TEST

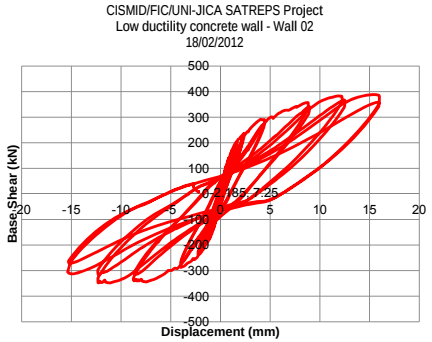
LOW DUCTILITY WALL TEST

ADQUISITION SENSORS FOR MEASURING

CH-NUMBER	RANGE	TIPO	UNIT	ORIGIN
CH-0	25	ACT. 25t/4755μ	T	AXIAL LOAD
CH-1	50	JACK A	T	FEEDBACK HORIZONTAL LOAD-A
CH-2	50	JACK B	T	FEEDBACK HORIZONTAL LOAD-B
CH-3	100	CDP	mm	HORIZONTAL DISPLACEMENT SOUTH
CH-4	100	CDP	mm	HORIZONTAL DISPLACEMENT NORTH
CH-5	50	CDP	mm	HORIZONTAL DISPLACEMENT EAST H/2
CH-6	50	CDP	mm	HORIZONTAL DISPLACEMENT WEST H/2
CH-7	30	CDP	mm	HORIZONTAL DISPLACEMENT EAST H/6
CH-8	30	CDP	mm	HORIZONTAL DISPLACEMENT WEST H/6
CH-9	30	CDP	mm	VERTICAL DISPLACEMENT EAST H/6
CH-10	30	CDP	mm	VERTICAL DISPLACEMENT WEST H/6
CH-11	50	KY 2794μ/FS	mm	DIAGONAL DISPLACEMENT EAST
CH-12	50	KY 2819μ/FS	mm	DIAGONAL DISPLACEMENT WEST
CH-13	30	KY	mm	HORIZONTAL DISPLACEMENT EAST H/6 CENTER
CH-14	30	KY	mm	HORIZONTAL DISPLACEMENT WEST H/6 CENTER
CH-15	10	CDP	mm	HORIZONTAL DISPLACEMENT EAST BOTTON BASE
CH-16	50	CDP	mm	VERTICAL DISPLACEMENT WEST
CH-17	50	CDP	mm	VERTICAL DISPLACEMENT WEST
CH-18	50	CDP	mm	VERTICAL DISPLACEMENT EAST
CH-19	50	CDP	mm	VERTICAL DISPLACEMENT EAST
CH-20-ST 07	2000	gage factor 2.08	μ	EAST Φ 1/2 BORDES
CH-21-ST 08	2000	gage factor 2.08	μ	EAST Φ MALLA DE MURO
CH-22-ST 09	2000	gage factor 2.08	μ	EAST Φ MALLA DE CIMENTACION
CH-23-ST 10	2000	gage factor 2.08	μ	WEST Φ MALLA DE CIMENTACION
CH-24-ST 11	2000	gage factor 2.08	μ	WEST Φ MALLA DE MURO
CH-25-ST 12	2000	gage factor 2.08	μ	WEST Φ 1/2 BORDES

CONTROL SENSORS FOR DRIVE JACKS ON CONTROLLER

CH-MONITOR	RANGE	TIPO	UNIT	ORIGIN
CH-1	50	JACK A	T	FEEDBACK HORIZONTAL LOAD-A
CH-2	100	CDP	mm	JACK CONTROL MASTER
CH-3	50	JACK B	T	FEEDBACK HORIZONTAL LOAD-B
CH-4	-----	-----	-----	-----



CONCLUSIONS

- Some of the outputs reached in the second year of Japan Peru SATREPS project were presented.
- Two districts of Lima city, La Molina and San Juan de Lurigancho were investigated and diagnosis of the seismic risk was performed in terms of retrofitting cost.
- Geospatial data base has been generated of the stock of buildings was produced in order to evaluate the vulnerability of the structural systems in the zone.
- Geotechnical microzonification was performed to produce the soil characterization of the area and the maximum accelerations that can be affected the districts.
- An introduction of the socio economical parameter is introduce in the determination of the seismic risk producing different functions for the diagnosis.